The Science Teacher

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IN THIS ISSUE----

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The Science Teacher

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The Biology Minded Community

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There is a feeling in many quarters that biology, in spite of its wealth of humanistic material, has not been elevated to the same high estate by the public at large as it has by the profession itself. This becomes particularly obvious when some subjects that many of us do not regard as sciences not only have been sold as such to the public, but have even been put over as extremely practical ones. For example, a young lady in college when asked to select a science to meet the demands of her curriculum, chose geography because it was so practical.

If biology is ever to occupy the high position to which it is entitled it must be through public appreciation of its possibilities. However, I trust that no one expects me to give the formula for producing biology-minded communities, for if there is one thing I am certain of, it is that no two communities are alike in the factors to be considered in effecting this desideratum. I hope to discuss it with you, but I am sure that you will get better ideas by discussing it with each other and by the exchange of experiences.

Before we can even discuss biology in relation to the community we are compelled to be introspective. An honest answer to such self-examination would force most of us to admit that we teach biology much as it was taught to us, and that we teach first, and, if need be, justify our teachings afterwards. We are very much like the country school teacher in Northern New York. The story goes that Professor Dewey was visiting in those parts some forty years or so ago, and, stopping in at a rural school, observed a hen setting upon a nest in a corner of the room. Professor Dewey inquired about this surprising thing, and was brightly informed by the young school marm that it was an object lesson. Now I suppose I must tell you what an object lesson is, for nobody to whom I have ever told the story seems to know. An object lesson was a rather effective educational device used by our grandparents—it stood somewhere between a demonstration and a dramatization minus the undesirable features of either. The story then continues that about ten years later, Dr. Dewey again finding himself in that community, and with time to spare, remembered the little country school and turned his steps thither. Imagine his surprise to see for a second time a hen setting on a nest in a corner of the room. Upon inquiry, the school-marm, who proved to be the same one, informed him that it was one of the children's projects. After digesting that one for about five years, Dewey, again hearing the call of the wild, repeated his visit to the little red school and was not at all surprised to see what he expected. This time, the now not-so-young teacher peered at him through thick glasses and solemnly informed him that they were studying a unit on reproduction. After writing several dissertations upon this find, Dr. Dewey, after a lapse of some years, eagerly returned to his happy hunting ground with high hopes. He was not disappointed. It was the same setting, but let's hope not the same setting of eggs. In answer to Dr. Dewey's customary query, the teacher looked over her glasses, and, recognizing her caller, proudly explained that it was an activity

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devised by the children; In telling this story to my methods class I always stopped there, but about five years ago, when we had a change of administration at Normal, a bright lad in the rear of the room raised his hand and said, "Dr. Lamkey, you haven't finished the story." "All right," I responded, "you continue with it," and he did, to this effect.

"Last year Dr. Dewey ran out of ideas and again went hunting. He was rather surprised to find that his foot steps had led him to the source of all his educational theories, District School, No. 71. Upon opening the door he saw the same old hen resolutely setting upon the same old nest, still determined to hatch chicks out of door knobs. Upon seeing her visitor, the teacher hobbled across the room, and after a couple of quavering "what's thats", anxiously asked Professor Dewey if he didn't regard the set-up as a good lesson in character building!"

Of course, you know my purpose in telling the story. We teach what we have always taught and meet the new trends by proudly giving things a new name. Almost anything we care to teach in biology may be justified, but we make the mistake of not seeking more justifiable material.

In order to start our discussion with something tangible, I shall repeat a quotation which I used in this same room some four years ago. "I am of the opinion that it would be a good thing to require biology as one of the basic sciences in our high schools, provided the social aspects of it are emphasized. There aren't many courses that lend themselves to the development of the socially worthwhile aims as biology does."

The thought in this quotations is just exactly what most of us are not doing or we would have biology-minded communities. However, the sentiment expressed is nothing but a glitetring generality unless we know how biology may be made "socially worthwhile". Yet, in spite of the lack of specific knowledge, there is a growing conviction that biology should be organized around the problems of life and society instead of around moribund earthworms and abstract evolution.

We believe that a teacher of biology is "socially worthwhile" if her influence extends beyond the classroom to such an extent that she becomes a social and civic asset to the community in which she resides. We believe a school board has the right to expect this and we further believe a community has the right to expect a teacher to know more than that which is essential to the mere presentation of classroom work. In other words, we believe that a community has the right to expect a teacher of biology to be somewhat of a local authority in the field in which she is teaching, and to know the relation of her field to education and life in general.

Putting it another way, why not make the school the biology center of the community—a center to which people may turn for advice in regard to the identification of plants, insects, and other animals; a place to which people may look for information regarding the growth and cultivation of plants, diseases of plants and their treatment as well as the control of household pests and the common infestations of pets and domesticated animals? And it is to be hoped that it may be a place where people may learn how to use plants for individual pleasure and for civic improvement. And why not make it the health center of the community to which people may turn for advice in regard to the safety of water and milk supplies, the bacteriological principles governing contagion and infection in public places, susceptibility to disease, and an intelligent understanding of the scientific principles governing the artificial immunity which may be set up as a precaution against such diseases as smallpox, diphtheria, typhoid, scarlet fever, and the like? And why not make it a focal point to which people may come with the problems of adolescence as well as the perplexities of social hygiene, including unbiased information in regard to alcohol and other narcotics and turn these things to good account in the improvement of community ethics and morals?

To counteract the view that this idea of affecting the morals and ethics of a community through biology is not just the idea of a scatter-brained sentimentalist, let me quote that good old stalwart Millikin, who says, "It is an exceedingly wholesome thing to work at some time

in one's life in a field in which the distinction between right and wrong, between loose and correct thinking, cannot be obliterated or escaped; to learn that there are eternal physical laws and presumably also eternal esthetic, moral, and social laws in conformity with which one must proceed if he is to arrive at correct results."

I know that this order looks imposing, and, as a matter of fact, it is an impossible one unless the aims and objectives of the high-school biology field are carefully scrutinized. It is rather obvious that if high-school biology is to affect the community it must consider the social, esthetic, and the ethical implications of the field as well as the strictly scientific human welfare phase. In other words, biology must earn its way by the richness of its contribution toward the solution of the social, ethical, and physical welfare problems which confront any group of people.

I feel, however, that while I have advanced that which is good in sentiment, I have contributed little of a practical nature, and such is usually the state of affairs in educational palavaring — one group has a pelthora of ideas, another group is surfeited with subject matter, but never do the twain meet. Not having much of either(anything which I might offer will undoubtedly appear to be very unsophisticated, but at least will have the merit of actuality. My specific suggestion, then, is that a boilogy teacher study the methods of a successful Smith-Hughes Vocational Agriculture teacher. In spite of some present-day ranting about the merits of a general education versus vocational training, no phase of high school education has taken on more social significance than has Smith-Hughes Agriculture. So, I say, you might do well to study its methodology, for the Smith-Hughes Agriculture Department has indeed become the social, as well as the vocational center of the farming public. All types of agricultural activities center on the school, the teacher visits the farmers, supervises projects, he is the agricultural adviser for his school district, he organizes clubs, he holds a series of night meetings and demonstrations connected with the chief agricultural enterprises of his community, he organizes and teaches adult classes and he promotes the social life of his agricultural district. I doubt if any division of education at any level has become more community-minded than has Smith-Hughes Vocational Agriculture since the organization of the first statewide system in 1917.

Could not a biology teacher hold evening meetings for adults interested in various phases of biology? A fascinating subject at this time of year might be fall gardening. Don't know anything about it? Doesn't matter, somebody in your community does—invite him in. How about migratory birds? Some duck-hunting man or boy can hold the attention of the group for you. How about vermin eradication? How about adult education upon the relation of the child's health to its pets with further information as to the source of intestinal parasites. Are you good at field trips? I knew an instructor who made field trips every Saturday morning and extended an invitation to the general public. I knew another instructor who has a whole community biology-minded, because everybody knows that she is a collector and takes pleasure in finding out the names of the unknown specimens presented to her. Other instructors take their classes to visit outstanding gardens, dairies, farms, and the like. One instructor discreetly cleared up the milk supply of a small town and received a handsome boost in salary. Another did the same thing for water. Another instituted a sanitary garbage disposal system. A whole school sys em is nutrition-minded because the instructors, in a required course in hygiene, in addition to other things, have invited the home economics teacher in to demonstrate to their classes the preparation of simple, wholesome meals. I have known parents to call upon teachers and congratulate them on their success in ge ting Johnny or Mary food and health conscious. I have even seen the pre-school population of a community absorb a working knowledge of vitamins and sanitation. A wise teacher can do much community work through

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OUR FRONTISPIECE

The picture on the front cover representing animals in their natural setting illustrates how true to life in every detail are animals shown in our better museums. The educational value of these places that are within the reach of the teacher and his school should not be overlooked.

I. A. C. T. TO MOLINE

In early April the Illinois Association of Chemistry Teachers will meet at Moline for its regular Spring Meeting. The invitation to Moline was extended by M. W. Pratt of that city and was unanimously accepted by the Association as it gives an opportunity for its members to meet with the science teachers of that part of Illinois. Arrangements for the program are in the hands of President John C. Hessler of James Millikin University, president of the Association. He would appreciate any suggestions as to the type of program the teachers prefer. Teachers should begin now planning for the meeting as it no doubt will be of the same high standard as usual. Moline also offers excellent opportunities for a field trip.

Illinois chemistry teachers may like to know as a matter of information that their State Association has already shown a decided growth in membership as compared to the previous year. Many further additions are expected before the Spring Meeting. Every science teacher of the State should see to it that he not only becomes but remains an active member. **The Association goal is a 100 per cent membership in good standing.**

INDIANA SCIENCE MEETING

Indiana chemistry teachers have decided to meet this year at Muncie during the Easter Season at about the same time as last year. Further announcements as to the exact time and program will appear in a later issue of The Science Teacher. Mr. Charles D. Dilts of Ft. Wayne, president of the Indiana High School Science Teachers Association, no doubt would like to hear from Indiana teachers as to desirable program material.

OTHER SCIENCE MEETINGS

This year the American Association for the Advancement of Science and allied organizations in the science field, including the American Science Teachers Association are meeting during the holiday period in Richmond, Virginia. We should remember the hospitality of this area and the attractive climate at this season and plan accordingly. The quality of the meeting is always assured.

A TWELVE YEAR SCIENCE PROGRAM

The twelve-year science program for grades and high school is now one of the problems science teachers may well consider. It has been brought into the limelight by progressive science educators and by the brilliant work done in a number of schools. The set-up in the Cleveland schools has been receiving much attention, but there are many others making noteworthy achievements. Now that all courses are being reorganized to eliminate dead timber and to apply more nearly the needs of the average student, it is appropriate to think and act to secure a better science program.

Does natural science require a twelve-year program to extend through the senior high school? It is not difficult for high school science teachers to see the value of a science program in the grades. They already complain of the limited time in which the facts, concepts, and generalizations are supposed to be taught. They recognize the lack of any foundation on which to build the high school course.

But let us examine more carefully just what a twelve-year program would mean to the student. It would mean a slow but permanent growth of understandings that would more likely be functional than when acquired in a short time. For example, arithmetic in the grades is not reserved for the last two or three years even though at that age there would be a great economy in the time needed to learn the mathematical concepts of numbers including addition, subtraction, multiplication, division, fractions, etc. The greater time spent on arithmetic permits it to become more usable through more practice. Finally the basic operations require so little thought that practically all the effort can be directed to mastery of more advanced mathematical concepts and applications. Furthermore, the extended time spent upon it insures that it will not be quickly forgotten.

The same principles that apply to the learning of mathemtatics apply to the mastery of science. Most of the vital concepts and generalizations in this field can be broken down into simple learning elements, many of which can be understood even in the lower grades. Archimedes principle of the buoyancy of liquids is being approached when elementary students consider why things float or sink in water. Such concepts as "things that are light for their size float" and "things that are heavy for their size sink" are fundamental. The idea of chemical change and some of its effects on our welfare is easy enough to comprehend in the grades. A concept of the nature of gases may be gained through the study of oxygen in air and its relation to life and health. These concepts and many others gained through suitable experience and applied again and again in problem situations would place the student in a position to grasp easily the science presented in the high school and to apply it intelligently to life situations. He would not be confused with so many facts and principles being presented all at one time. The more elementary concepts would already be a part of his usdraw without special effort. His mind would be more nearly free to think.

Already courses are being developed for the grades. Attention is being given to the work by some of our leading universities. Important work is being done by Professors Powers and Craig of Columbia University and Professor Beauchamp of the University of Chicago. Publishers are offering a variety of texts. Much experience is being gained in the class room that will guide the program to a greatly improved form.

As to courses at the high school level, we may expect under a twelve-year program to see marked change in adapting subject matter to social needs. Certainly we would agree that science has something to offer to all students and is not merely for the few preparing to study it in college. If so, then the material presented must prove of value either socially, economically, or both, in order to attract the students to science courses. Already courses of radically different nature are being offered and much experimental work is going on. All science teachers need to be alert to developments. It appears that science associations should have an active part in studying the problem and meeting the situation.

—JOHN C. CHIDDIX.

Recent Developments in Diagnostic Testing

SETH A. FESSENDEN

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Testing is not a means to compile data for some possible use. The only excuse that a teacher has for using any test is to discover some fact or attitude which may be utilized to more rapidly advance the learner on this way through education. A beautiful hospital chart of a patient is useless unless that and the data thereon are used for the benefit of the patient. Tests are, of course, a means to an end, not ends themselves. Tests should be used only when they promise to yield information of a predetermined nature. We should not test and then hope to find a use for the results.

It is our job to learn a pupil before we attempt to teach him. We should think of ourselves as leaders whereas our business is to help each individual student develop and become as effective, happy and constructive a member of society as that society hopes the schools will be able to produce.

According to the thirty-first yearbook of the National Society for the study of Education, the Committee on the Teaching of Science announced two main objectives for all fields of science. Considering chemistry as a major branch of science, I have accepted these objectives as fundamental in this discussion. You probably know them; they are:

1. To give a functional understanding of major generalizations or principles, and
2. To include scientific attitudes.

In this committee's report subject-matter was not considered in itself as of primal importance, but merely as a means to more valuable ends. Assuming such objectives as fundamental, it is rather difficult to justify some tests which endeavor only to determine the volume of factual knowledge possessed. Diagnostic testing in the fields of these objectives is a difficult task and requires much more than the mere consideration of the test scores.

Howver, before entering into a discussion of diagnostic tests, it seems desirable to consider briefly certain other types of tests and their immediate importance upon diagnosis. Let us eliminate the very important physical, emotional, social, and environmental factors which contribute so greatly to learning, and which must be taken fully into account for a satisfactory diagnosis, and consider their interpretation and inclusion as part of the responsibility which the teacher must assume. Because each pupil is an individual, diagnosis is extremely complicated, but much can yet be done by the average teacher of chemistry.

Considering our diagnosis of pupil-difficulty from as "testingable" point of view as possible, there are three types of these tests which should be used, intelligence, achievement, and diagnostic tests. An intelligence or psychological test is very valuable to aid in our recognizing the varying ability among problems which arise from the use and interpretation of intelligence tests are far too numerous to attempt to discuss here. Let it suffice to say that an intelligence test will help greatly in discovering the probable reason for the difficulty of some pupils. Yet, with a diagnostic test the means of remedy may also be discovered.

Most chemistry tests are in reality achievement tests. These tests are used to determine the degree of mastery of the subject-matter. In fact, in spite of the stated objectives, to date the vast majority of the diagnostic work seems to have been held to the treatment of the knowledge of subject-matter. Such tests deserve every consideration if we consider knowledge of factual information the essential goal. Otherwise they are but a portion of a complete program. It is relatively easy to determine the extent of learned facts. Rote memory developed by drill can supply the weak points. But unless a pupil can show that he can apply his knowledge of scientific facts to the solution of so called practical problems, he has, in reality, achieved

nothing, regardless of his ability to reproduce any given number of facts.

Still these achievement tests are valuable in diagnosis. They measure the degree of progress and the rate of improvement. A diagnostic test is, to a large extent, a specialized achievement test. For superior diagnosis these tests should be delicate enough in balance to permit a teacher to note the progress over a period perhaps no greater than a week in length. For this reason any test chosen should have at least two forms correlating both odd-even and the forms above .90.

The achievement tests that are on the market now in the field of chemistry are designed to test progress in some or all of the following phases of the work:

1. Acquisition of information.
2. Understanding of important technical terminology and symbols.
3. Acquaintanceship with various chemical processes and the functions of structures involved in those processes.
4. Ability to recognize unsolved problems in science.
5. Ability to draw reasonable generalizations from experimental data new to the students.
6. Ability to plan experiments to test hypotheses.
7. Ability to apply scientific generizations to new situations.
8. Skill in laboratory technique.

The achievement tests which I am submitting for your inspection test with varying degrees of adequacy most of these fields. Let us consider a half dozen of these test forms in this light. Let us use the New Cooperative Chemistry test Form C which is still in its confidential state, the 1938 Cooperative Chemistry Test, the Persing Laboratory Chemistry Test, the Columbia Research Bureau Chemistry Test, the Glenn-Walton Chemistry Achievement Test, and the Differential Study Guide in Chemistry.

They all test three of these fields, the acquisition of information, the understanding of important terminology and symbols, and the acquaintanceship with various chemical processes and the functions of structures involved in their processes.

All but the Persing, which is primarily for checking laboratory technique, test two more fields, the ability to draw reasonable generalizations from experimental data which are new to the students, and the ability to apply scientific generalizations to new situations.

All but the Cooperative Chemistry Test form C and the Columbia Research Test deal also with experimental and laboratory technique.

Though all but the Persing cover the principal points other than laboratory methods, the only test which seems to me to deal with all eight fields is the Educational Test Bureau's Test known as the Differential Study Guide in Chemistry. This, however, is too detailed a test for regular usage or frequent check-up. The time required to administer is three hours. I seriously question the desirability of such detail except for a purpose such as this test was intended. The statement of purpose as set forth in the manual explains that it is a general achievement test and "is designed primarily for use as an achievement and diagnostic device to be administered after students have studied general chemistry for one and two semesters."

Frankly, without knowing individual situations I could not recommend any of these tests above the others. They are all standard and are sufficiently selective to meet your demands. The choice of test must be determined by the condition you wish to check on.

It will be noted from these facts that the relationship between diagnostic testing and achievement testing is very close. In the main, it is the use of the test which determines whether it shall be called achievement or diagnostic. Diagnosis involves not only measurement but also interpretation. A test can measure, but the real diagnostic interpretation is up to the teacher.

If in our teaching it were possible for us to use such preventative measures that the desired outcomes of learning could be guaranteed and the undesirable attitudes eliminated, diagnostic and remedial work would be unnecessary. But we have not

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Federal Soy Bean Research

O. E. MAY

U. S. Regional Soybean Industrial Products Laboratory Urbana, Illinois

(Continued from October Issue)

The laboratory is now equipped to make accurate measurements of drying rates by means of a Sanderson type drying meter carrying 12 plates. This apparatus is installed in a constant-temperature constant-humidity room carried at 77 degrees F. and 50 per cent relative humidity. All test panels are painted in this room so that absolutely comparable conditions are had at all times.

Very complete apparatus for molecular distillation has been set up which includes two pot stills and a column type still. The apparatus functions quite satisfactorily so far as preliminary tests indicate. Soybean oil has been hydrogenated to an iodine number of 2 and subjected to fractional distillation in one of the pot stills. With a temperature range of 165 to 260 degrees C. and at a pressure of less than 0.01 microns a marked degree of fractionation of the glycerides was obtained. For example, fraction No. 3 which was distilled in the range of 231 to 240 degrees C melted at 59 to 60.5 degrees C., while fraction No. 6 distilled at 260 degrees melted at 68 to 69 degrees C. All of the fractions which were distilled from 240 to 260 degrees C. were white products apparently of a high degree of purity. It is hoped that this molecular distillation apparatus will prove of considerable utility in studies of the minor constituents of soybean oil and particularly those substances which occur in small quantities but may be of considerable importance in determining the flavor and odor stability.

An important study has been completed on the effect of hydroxyl and peroxide groups on the measurement of the apparent conjugated double bonds in soybean and other vegetable oils. In studies initiated some months ago on the stability of edible soybean oil and on changes which take place in the heat bodying of soybean oil the Kaufman and Ellis methods were used in attempts to estimate quantitatively the development of conjugated double bond systems. Conflicting and anomalous results were obtained and it became necessary to ascertain the limits of the methods at hand for applying the diene reaction. It was found that presence in an oil of hydroxyl and peroxide groups very definitely affects the magnitude of the diene value and hence gives misleading and erroneous results for the estimation of conjugation. It is felt that these results will prove of great value in the broad field of vegetable oils and will emphasize the necessity of interpreting diene measurements with extreme caution.

Extension studies have been carried out in the meal section of the laboratory concerning the properties of water dispersions of the nitrogenous compounds of soybean meal. As has been mentioned earlier in this paper, 90 to 95 per cent of the nitrogen compounds of soybean meal can be dispersed by distilled water. Defatted meal has been used in all of these studies. The effect of added salts on the solubility of the nitrogen compounds was studied extensively. This information is being published in the various chemical journals. Evidence was obtained showing a distinction effect on the dispersion of the protein. It was found that the divalent cations showed a greater inhibiting effect than the monovalent. Through certain concentration ranges lyotropic series effects were definitely found. It has also been noted in connection with this study that the amount of protein material that can be extracted from the meal with water or salt solutions decreases with the passage of time. The definite rate of this decrease and the limit it approaches are not known at present. The study of the effect of hydrogen ion concentrations of the extracting solution upon the dispersibility of nitrogenous matter of soybean meal has also been carried out in the presence of acids, alkalis, and salts. This investigation is still underway and is expected to lead to some very interesting and important results. When considered

in conjunction with the data dealing with salt effects, already assembled, the results of the study of pH effects on the solubility of soybean protein fill many wide gaps in our knowledge of the behavior of these protein dispersions and should furnish a firm foundation upon which to base a more intelligent approach to many problems connected with both the laboratory and workscale extraction of useful protein from the soybean.

The whole important question of the fundamental relationships of protein to water are also being investigated from several different aspects. Only a beginning has been made here but comparative studies have been completed dealing with the relationship between water content and plastic flow of soybean protein, casein, and zein. It was found that zein when moisture free possessed measurable flow under the conditions of the experiment. Soybean protein on the other hand did not flow when the moisture content was reduced below 2 per cent, while no flow was obtained with casein when the moisture content was lower than 4.5 per cent.

Important progress has been made in the development of interesting plastic materials from soybean protein. It was discovered that soybean protein could be treated with formaldehyde solution, and, when dried to a powder, that it possessed thermoplastic properties and could be molded, as long as the moisture content was at least 5 per cent. This is entirely contrary to the literature and has not been used heretofore, so far as the laboratory is aware, by the casein plastic industry. The soybean protein which is commercially available today may be used in this process. When the protein is treated with formaldehyde solution at a pH near the iso-electric point, a product is formed which when dried, ground to a powder, and molded produces a plastic that is tough, horn-like, transparent, of yellowish brown hue, and has minimum water absorption. It does not warp nor crack and readily takes pigments or dyes to give colors ranging from greys through reds, yellows, greens, and blues. When plasticized with glycols it flows readily but not readily enough in its present stage of development for use in injection molds. Since the material is thermoplastic the mold must be chilled before the object can be removed. These developments have been deemed of sufficient importance to protect them for the public use through application for patents covering their novel features. If and when issued, these patents will, of course, be available to the industry through non-exclusive license from the Secretary of Agriculture. There is considerable work yet to be done on these plastics derived from soybean protein. The material has a tendency to become brittle with age, and the water absorption, though less than one-half that of present commercial casein plastics, is still thought somewhat excessive for general utility. However, the plastic in its present state possesses considerable promise and has aroused appreciable interest throughout the trade.

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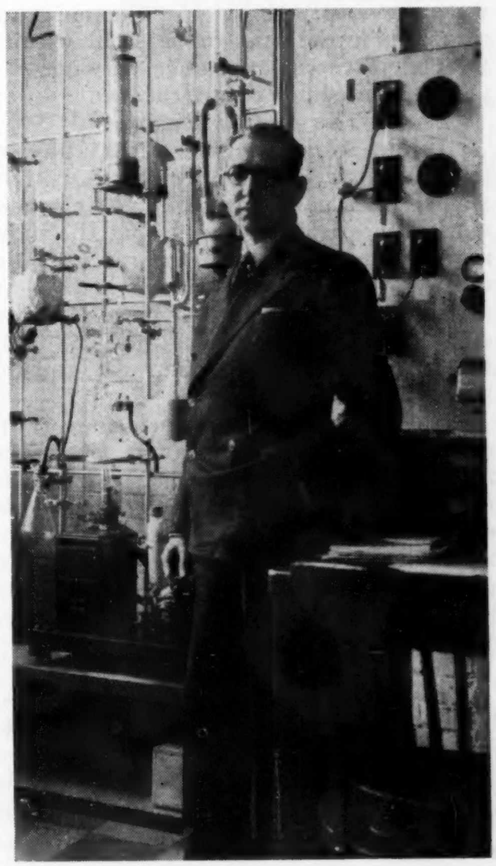

A manometric pump used in the U. S. Soybean Laboratories for precision work.

Visual Aids in Physics

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The old Chinese proverb "One picture is worth a thousand words" has probably never had the significance that it has today. Present demands of society upon the school require that more topics and an increased amount of subject matter be taught. This, in turn, necessitates the saving of time and consequently demands more effective and efficient instruction, for "the law and parents may guarantee the physical attendance of the child at school, but it is left to the teacher to insure his mental attendance."[1]

Later came, picture writing to take its place in the methods of imparting information. Many of the expressions which were previously verbal now became crude scratches in the sand or on stone or mud tablets, pictures long since serving as a potential medium of instruction.

The Motion Picture

While it is recognized that physics teachers have long used pictures, lantern slides, and post cards in their school work, there is little doubt that the moving picture, along with the radio, is the most potent and democratic method of instruction that has as yet been discovered. As one authority has put it, "Only the deaf are immune to the radio, and the blind to the movies."[2]

However, in our enthusiasm for the motion picture, it must not be presumed that we have reached the pinnacle of methods, and discard all our other methods, for the choice of any technique or method of presenting a subject should be determined primarily by the nature of the subject matter and the objectives sought.

Selecting A Film

In selecting a suitable film care must be taken that it meets the requirements for classroom use. The brief description given by the distributor's catalogue is usually very helpful but should never be taken as final. Films to be used in the physics class may be classified into four groups, namely: 1, films to motivate or to give an overview of the unit as for example, "Compressed Air" or "Hot Air Heating;" 2, films of the exposition type as "Optical Instruments," "Illumination" or refrigeration;" 3, films to supplement the text as "The Transformer," "New York Water Supply," or "Thomas Edison;" and 4, films to review the unit as "Induced Currents," "The Behavior of Light," or "The Chemical Effects of an Electric Current."

There should be no hesitancy in returning a film unused if it does not meet the purpose for which it was selected. The following criteria may serve as a guide in selecting a film:

(1) Is the content closely related to the topic with which it is to be used?
(2) Is the material presented, accurate?
(3) Is it within the mental capacity of the individual to whom it is to be shown?
(5) Does it contain any words or terms that are not as yet in the pupil's vocabulary?
(6) Is it likely to stimulate the pupils with a desire to know more about the subject?

Selection, however, does not stop here but is a continuous process. Not only should the teacher preview the film before it is shown to the class so that the pupils may be correctly prepared to receive it, but the teacher should study the reactions of the pupils to the film and this information filed for future reference.

Sources

A film may possess all the characteristics of a good classroom film and yet fail to be effective unless it is available at the time it is needed in the learning process. Therefore, a careful study should be made of the topics which are available and the schedule planned for at least a semester in advance.

1. Dorris, Anna Verona. "Visual Instruction in the Public Schools." Ginn and Co., 1928, p. 12.

2. Dale, Edgar. "A Motion-Picture Program." The News Letter, Ohio State University, June 1937, p. 1.

Especially is this desirable when films must be borrowed or rented.

Many good films pertaining to topics in physics are loaned free except for transportation charges. Films which are obtainable from State universities, departments of visual instruction, and similar educational agencies have been selected for their adaptability to the usual courses of study. The Visual Aids Service of the University of Illinois is an excellent example. This service has approximately forty titles pertaining to physics alone, of which more than three-fourths are scientifically planned teaching films with teachers' guides which contain a concise overview of the subject matter treated in the film with a description of each scene, suggestions for class procedure, projects, and topics for further discussion.

Some comprehensive catalogues of educational films are "1000 and One" a standard film reference source published by The Educational Screen Magazine, the "Educational Film Catalogue" published by H. W. Wilson Company and a "Directory of 16 mm Film Sources" published by the Victor Animotograph Corporation.

The Y. M. C. A. Motion Picture Bureau of Chicago has many industrial subjects which are loaned free. Many films of excellent quality on common topics in physics may be secured from the United States Bureau of Mines Experimental Station, Pittsburg, the General Electric Company of Chicago, Bausch and Lomb Optical Company of New York City, and Massachusetts Institute of Technology.

It is advisable that the teacher make a list of the films which are available with a brief description of each including the name of distributor, the number of reels, etc., and file this information in a systematic form so that it is easily accessible.

It is when the physics teacher has been using films in his classwork that other teachers in the system become interested and seek his cooperation. It is then that the principal usually delegates that teacher with the responsibility of helping others to select films and project them. Soon, more teachers are using the motion picture and the physics teacher is likely to find himself directing the visual aids program for the school.

Duties of the Director of Visual Aids

The duties connected with organizing and administrating a visual aids program are many even in the small school system. Briefly, the general duties are:

(1) To compile film sources and inform the teachers as to what is available.

(2) To preview, evaluate and assist in the selection of films.

(3) To act as advisor and coordinator in booking and scheduling of films.

(4) To give instruction in the use and care of the equipment.

(5) To distribute the films and schedule operators of the machines.

(6) To supervise the operators and assistants.

(7) To keep records, compile statistics, and make reports to the distributors and to the principal.

(8) To aid in planning and spending the visual aids budget.

(9) To return borrowed and rental films on the designated dates.

Of course, it is quite obvious that the director will need to choose several assistants to work under his direction and to whom he can delegate definite responsibilities. Among these is a secretary to take care of the correspondence, the clerical work and to keep the records. Incidentally, this is an opportunity for the physics department to do some correlating with the commercial department.

Apprenticeship Plan

Students chosen to operate the movie machines and to care for the equipment should be selected on the basis of responsibility, interest, and mechanical ability, with the senior members assuming the heaviest responsibilities. They operate the sound machine and train the junior members in its operation. The junior members, in turn, have charge of the silent projectors and train the beginning group of operators. No boy should be allowed to operate a machine alone until he has proven himself to be capable and efficient. Thus, he serves a sort of apprenticeship which is not unlike that of

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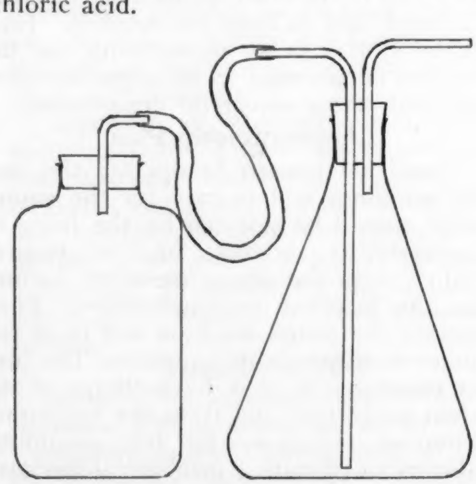
Dry Ice as a Source of CO_2

ALLEN R. STACY

George Washington High School Indianapolis, Indiana

Dry ice as a source of carbon dioxide in various laboratory experiments is not particularly new, but the fact that its use is not very wide spread leads me to believe that chemistry teachers as a whole do not realize the virtues of this rather commonplace article of our present civilization. If one realizes that one cubic centimeter of dry ice will produce 450 cubic centimeters of pure carbon dioxide gas, he will readily see that here is a good supply of carbon dioxide which is far simpler to handle than Kipp generators or makeshift apparatus. This is particularly true in the Solvay experiment for producing baking soda.

Who of you has not had his laboratory cluttered with a forest of five-foot glass tubes sticking out of generators in order to obtain a sufficient pressure of carbon dioxide to secure a good yield of soda? Those days should be gone forever because as we shall see in a few minutes, the dry ice upon expanding creates sufficient pressure as well as a plentiful supply of carbon dioxide. In addition to its superior ease in handling, dry ice is also considerably cheaper as a source of carbon dioxide than marble and hydrochloric acid.



About a year ago, I had two sections of Chem. IIs performing this experiment at the same time. One section met the first thing in the morning while the other section met later in the day. I was unable to obtain dry ice early enough to supply the first class and so I had them set up the old-fashioned generators while we used dry ice in the other class. The first section required about $1.20 worth of hydrochloric acid alone in performing the experiment, not to mention broken tubing and other incidental expenses. The other section used only 20 cents worth of dry ice, had ample for their needs and some left over.

The apparatus, as you can see from the direction sheet, is extremely simple and one could even use only a flask, adding the dry ice directly to the ammoniacal brine were it not for the fact that the low temperature of the dry ice freezes the mixture before a good yield of soda can be obtained.

Five pounds of dry ice is sufficient for a class of 24 working in pairs. We usually fill a gas bottle about 2-3 full of dry ice chunks to use as a generator which we connect to the absorption flask by means of a fairly long piece of rubber tubing. Water added to the dry ice in the generator will cause a faster evolution of the gas, but this is really unnecessary as a sufficient quantity of gas is given off without the addition of water.

One difficulty presents itself in the use of dry ice, and that is, that it is impossible to completely close the apparatus, due to the high pressure developed by the evaporating dry ice. As a consequence, some of the mixture has a tendency to shoot out over the surroundings during agitation.

Experiment: Preparation of Sodium Bicarbonate (Solvay process).

Objectives: To study the reaction whereby sodium bicarbonate is prepared commercially.

Materials: Common salt, 30 gms; concentrated ammonium hydroxide (Sp. G. 0.90) 36cc; filter paper and funnel; gas bottle; Ehryenmeyer flask; stoppers;

(Continued on page 19)

Field Work in High School Biology

MARGARET MIDDLETON

University of Illinois Urbana, Illinois

(Continued from October issue)

2. (From P. K. Houdek).

These are spring trips to be taken in the woods, ravine, meadow, pasture, roadside, or park—the farther from town the better. Each student is required to have a pad of bird lists and two or three inexpensive bird books. When available, field glasses are taken along. Most of the time is spent with the class moving slowly and quietly along the route with each member on the lookout for birds. When a bird is sighted it is studied and if possible named. Snap judgments are discouraged and when possible students are asked to judge sizes, markings and colors before a name is announced. We do not attempt to name every bird we see. Bird nests are watched for and observed from a distance. If a bird that is rare or newly arrived is discovered it is located in the bird books and the notes and descriptions read aloud to the class. Upon reaching a suitable location on a stream or on a hillside the class is instructed to find seats in a rather close group. Strict silence is observed. A close watch is kept for birds that happen to come within the line of vision. Very often the songs of birds are heard in this quiet study that are never heard under other conditions. Careful records of observations are kept. Additional notes may be written on the backs of the sheets. One write-up may include several trips.

A sample of the bird lists:

Marks for: . . heard: . . seen: . .

Date: . . . . . .

Observer: . . . . . .

Place: . . . . . .

No. Observers: . . . . . . Species: . . . . .

New arrivals: . . . . . . Weather: . . . . .

Temperature: . . . . . . Wind: . . . . . .

(There follows a list of birds with blanks after each.)

Natural History Field Tours

1. Field Museum in Chicago. (from M. C. Lichtenwalter, Lane Technical High School, Chicago, Illinois.)
   a. Mimeographed bulletin:
      1. Problem: How do animals survive as the result of special adaptations to their environment?
      2. Materials needed: parents' permission, carfare, mimeographed guide map of the museum.
      3. Work sheet of the problem to be filled in by the student:
         e. g.—on the White-tailed or Virginia Deer.
         a. There are three groups: the autumn, spring, and summer groups.
         b. Space for sketch or picture postcard of group.
         c. Paragraph of descriptions with blanks to be filled in with one or more words—e.g.:
            "The White-tailed Deer shows marked external differences with the change of (seasons). In summer its hair is relatively (short) and (thin), and has a rich (reddish rufous) color. It is during this period, from (May) to (September) that the antlers, covered with a (fuzzy) (skin) known as (velvet) attain their annual growth. Normally, the female or (doe) never has antlers."
            Etc.
2. Natural History Museum, University of Illnoís, Urbana, Illinois. (from L. A. Astell.
   a. A mimeographed list of questions arranged in much the same order as are the phyla displays in the museum. Answers for the questions may be had from the exhibits, in most cases, as e. g.,

1. Molluska: List observations on the variations in shells as to color, etc. From where did the Florida Tree Snails originally come?
2. Protozoa: Sketch rather in outline form Heleopera picta.
3. Porifera: What use do the Japanese make of the Venus' Flower Basket?
4. Etc.

Enemies (from P. K. Houdek)

Enroute to the location in some ravine, woods, or pasture or roadside the instructor collects a partially eaten leaf, gall, an acorn, or nut with a worm hole, or any other evidence of an enemy relationship. The class is usually seated for instructions. The items collected are explained briefly, in eachcase naming the enemy and the host and vistim. The group is then divided into pairs usually of their own choosing. Each pair is instructed to find as many cases of enemy relationships as they can, make notes on them and bring back some bit of evidence for each case. About fifteen minutes is allowed for the collecting. Given a few minutes to complete their notes a survey of the class determines which group has made the most finds. This group is then asked to read their list and show the bits of evidence to the class. When this is completed other members of the class are asked to show any additional cases. During the recess period those groups with only three or four examples are asked to use this time for further search. The write-up is made at the next laboratory period. Interesting bits of evidence are saved, the rest discarded.

Seed Dispersal (from P. K. Houdek)

This trip is usually taken in the fall. Roadsides, pastures, vacant lots, and open woods may be used. Each student is provided with a small paper sack. Seeds are collected as they are found. Notes are taken on each new specimen and when a nw type is found it is discussed by the entire class. Names are given (if possible by the students) and in the notes the various specimens are placed into groups according to their method of distribution. Each student collects a few seeds of each kind keeping them in the paper sacks. A constant watch is kept for seeds actually in the process of being distributed, and if they are seen notes are made. The following types are used:

Seeds distributed: by wind; by animals and man; by hooks; by water, and by mechanical means.

Notes and specimens are used later in the laboratory for the write-up of the trip.

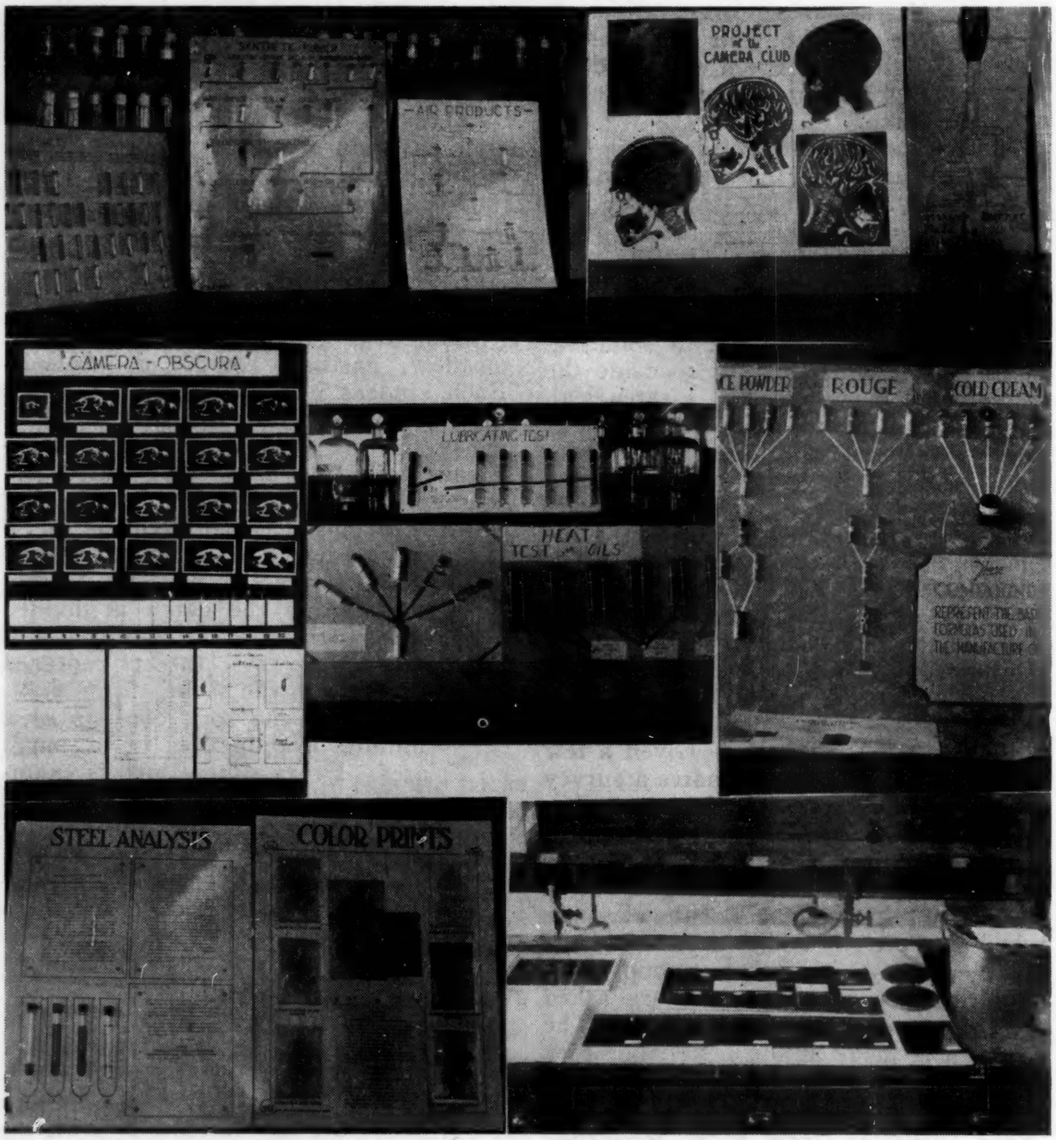
Insect Study (from P. K. Houdek)

How to collect insects:

This trip is taken in the fall to a meadow, pasture, woods or roadside. Each student is provided with a paper sack. All available insect nets and killing bottles are taken along. Four methods of collecting are demonstrated and practiced:

1. Sweeping: class divided into groups which are scattered and allowed to try this method. Within each group the catch is divided after each sweeping and each student has a try. Insects captured are kept in the sacks.
2. Searching the sod: consists of a minute examination of a small area. Every square inch is examined and every leaf, stone, and stick is moved in the search. After instructions, the class is lined up about ten feet apart with their backs to the sun and instructed to get down on their hands and knees for this study. This is continued for only a few minutes.
3. Catching butterflies: in a demonstration on the use of the insect net, the points emphasized are: 1. cautious approach with slow and deliberate movements, 2. bringing the net up from behind and below to within about a foot of the insect, 3. the rapid sweep, 4. waving the net to get the butterfly deep in the net, 5. lapping the bottom of the net over the rim, 6. the cautious removal. The class is divided into groups and sent out to practice for about ten minutes. Any butterflies that are caught are placed in the killing jars.
4. Ground insects: In a woods or along a roadside students are instructed to turn over boards,

(Continued on next page)



Project work of many Indiana High Schools was placed on exhibit at the Terre Haute Meeting of the Indiana High School Chemistry Teachers Association.

FIELD WORK IN BIOLOGY

(Continued from page 15)

stones, mats of eaves to search for insects. Decayed logs and stumps are torn apart with sticks. Any insects found are kept in the paper sacks.

Water Animals (from P. K. Houdek)

This trip may be taken in either fall or spring to a small creek or pond. A variety of containers are taken including fruit jars, pails, buckets, and tin cans. The insect nets are used as dip nets and if possible a small mesh minnow siene is taken. If no minnow siene is available strips of mosquito netting three or four yards long may be used. Upon reaching the location all containers are half filled with water and poles are cut or found for the nets. Two students work a net up-

stream or along the bank of the pond while one other student goes ahead to overturn the stones, throw out brush and poke a stick into holes in the bank to dislodge hidden animals. Upon landing the catch it is divded in the various containers. The dip nets are used along the banks and in shallow pools. Collections are returned to the laboratory to be examined and identified.

Outdoor Biology

A. A pamphlet published by Scott, Foresman and Co., under the title "Notes for Science Teachers." Contains two field projects.
   1. A field activity for spring: measuring the growth of trees.
   2. Summer biology. Contains a list of questoins and suggestions for finding interesting things to do in the summer.

A List of Identification Helps and Keys for the Students and Teacher

1. Keys for the Identification of Common Trees and Birds. Doris A. Plapp and Mabel E. Smallwood, Lane Technical High School, Chicago, Illinois. 28 pp.
2 Forest Trees of Illinois—How to Know Them. State of Illinois Dep't of Conservation, Springfield, Illinois.
3. Guides for the Beginning Naturalist—Aids in identifying common flowers, trees, rocks, and songbirds. Ronald L. Whitney. Webster Publ. Co., 1808 Washington Ave., St. Louis Mo.
4. Taxonomic Keys to Wildflowers, Grasses, and Trees. H. J. Fuller. Published by the College Book Store, Champaign, Illinois. Price $1.00. 38 pp.
5 Talking Leaves. Shows distribution of trees in U. S. also. Julius King. Harper Publ. Co., Cleveland, Ohio. Price 10c. 62 pp.
6. Birds and Flowers at a Glance. See "Talking Leaves".
7. The Wildflower Namer. A system of descriptive cards with cutout spaces of different sizes, which fit over each other so as to indicate the specific flower among the list on the bottom card. Horace Taylor, Walnut St., Brookline, Mass. Price 50c.
8. New Manual of Botany. Asa Gray. Am.Bk. Co. Price $3.00.
9. High School Flora. Cowles and Coulter. Am. Bk.Co. 144 pp.
10. Fieldbook of American Wildflowers. Contains descriptions of characteristics, habits, colors, and insects which assist in their fertilizatoin. F. S. Mathews. Putnam Sons. Price $3.00. 587 pp.
11. Familiar Trees and their Leaves. F. S. Mathews, D. Appleton Co. 320 pp.

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DIAGNOSTIC TESTING

(Continued from page 7)

reached that point. It is almost mandatory that we discover and correct missteps in order that we may control the total learning situation. For such, diagnostic work is needed. However, we must constantly bear in mind that we are dealing with individuals, and tests are standardized on groups. Every individual is different and the exception to the rule. Tests can help point the way, but they cannot determine a conclusion. There are many more important outcomes of learning than the accomplishment of the work assigned.

Nor is it so important to dicover what a pupil has not learned as it is to discover why he has not learned it. A diagnosis should go beyond the measurement of achievement and point the way to a remedy. It should make more effective learning possible.

Diagnostic activity in chemistry can not be considered as isolated from diagnosis of trouble in other fields. Courses overlap. The whole student must be examined. A discovered weakness in chemistry may well unearth a faulty learning process which affects a student's entire school work. The teacher must consider at all times that he is dealing with a very complicated machine and not a set of individual reactions.

The mental processes involved in the work are more important than the result itself. A diagnosis that indicates a weakness due to the incorrect interpretation of a law or theory is a valid interpretation only if greater emphasis on the interpretation of the data results in greater achievement on the part of that student. Thus, even though a diagnostic test reveals a low vocabulary of chemical terms, that may or may not be the true cause of failing work. But if this vocabulary is enriched and the grade of work improves, one may justly assume the vocabulary to have been the cause of the difficulty.

Ideally a diagnostic procedure should enable us to find first the major difficulty and then the specific weakness which contributes to this major deficiency. A discovery that a student can not apply the principles of chemistry to problems might be traced to a misunderstanding of a fundamental law. I have been unable to find a chemistry test which I would class as perfectly diagnostic. I doubt if such exists. But with these tests that are available it is possible for the instructor to find major fields of difficulty and then through the examination of individual problem-answers reach a fairly conclusive decision. Here again the problem of interpretation lies upon the shoulders of the instructor. It is for this reason that I have made my bibliography relatively broad. The instructor who plans on a diagnostic campaign needs have a fairly wide knowledge of procedures.

I believe it is safe to say that every student who fails or approaches failure does so because of a discoverable fact. If his level of intelligence is normal, an achievement test will rank him in relationship with other members of his class and with the "normal" for his age and advancement. It is not well to expect a high correlation between the achieve-test and intelligence test, however, as the latter cannot consider the interest or degree of effort. Beyond an achievement test, which is diagnostic to the extent of its subdivisioning, the instructor must consider all other personal, environmental, and physical factors before attempting a definite and conclusive diagnosis.

Diagnostic work is undoubtedly valuable and really essential to comprehensive teaching, but the technique involved in the interpretation of the present tests places a very large burden on the shoulders of the class-room teacher.

If you are seriously interested, my suggestion is to make use of the present standardized tests, but to supplement them with your own knowledge of the individual student. Tests can point the way, improve guesswork, but they cannot determine results mechanically.

References

Illinois High School Conference, November 1938. "Recent Developments in Diagnostic Testing". Bibliography Compiled by Seth A. Fessenden.

General References on Diagnostic Testing—

1. National Society for the Study of Education, 34th Yearbook; Report of the Committee on Educational Diagnosis; Public School Publishing Company, Bloomington, Illinois; 1935.
2. Green, H. A. and Jorgensen, A. N.; Youth and Interpretation of High School Tests; Longman Green and Company; 1936.
3. Lee, J. Murry; A Guidance to Measurements

in Secondary Schools; Appleton-Century Company; 1936.
4 Tiegs, E. W.; Management of Learning and Elementary Schools; Longman Green and Company, 1937.

Special References in the Field of Chemistry—

1. Powers, S. R.; A Diagnostic Study of the Subject-Matter of High School Chemistry; Teachers College Contribution to Education; Number 149; 1934.
2. Swan, J. N.; Standardized Tests for Chemistry Teaching; School and Society 44:275-7; August 29, 1936.
3. Carleton, R. K.; Some Observations on Testing Procedures in Chemistry; Education 56: 425-8; March 1936.
4. Malin, J. E.; Construction of a Diagnostic Test in the Mechanics and Related Fundamentals of High School Chemistry; Ph.D. Thesis, University of Pennsylvania; 1931. May be obtained through inter-library loan.

Bibliographic Listings of Available Tests—

1. Hildreth, G. H.; Bibliography of Mental Tests and Rating Scales; Psychological Corporation, New York, 1933. There will be a revised issue in the spring of 1939.
2. Buros, O. K.; ducational, Psychological, and Personality Tests of 1933, 1934, and 1935; chool of Education Study in Education, Number 9; Rutgers University; 1935.
3. State of Illinois Publication; Educational Tests for Use in High Schools; Circular Number 287; Issued by John A. Wieland, February 24, 1936.

Companies Publishing Chemistry Tests—

1. Bureau of Educational Research; University of Iowa, Iowa City, Iowa.
2. Center for Psychological Service; 2026 G. Street N. W., Washington, D. C.
3. Cooperative Test Service; 15 Amsterdam Ave., New York
4. Educational Test Bureau; 720 Washington Ave. S. E., Minneapolis, Minnesota.
5 Public School Publishing Company; 509 North East Street; Bloomington, Illinois.
6 Psychological Corporation; 522 Fifth Ave., New York.
7. World Book Company; 2126 Prairie Ave., Chicago, Illinois.

Some Available Chemistry Tests—

1. Cooperative Test Bureau.
   Cooperative Chemistry Tests, Three forms.
2. Educational Test Bureau.
   Differential Sutdy Guide in Chemistry, One form.
3. Public School Publishing Company.
   General Science Test, Two forms.
   Malin Diagnostic Test, Two forms.
   Persing Laboratory Chemistry Test, Two forms.
   Rich's Chemistry Test, Two forms.
4. World Book Company.
   Columbia Research Bureau Chemistry Test, two forms.
   Glenn-Welton Chemistry Achievement Test, two forms.
   Powers General Chemistry Test, two forms.
5 University of North Carolina.
   Diagnostic Test in Chemistry, One form.
6. University of Georgia.
   Physical Science Test, One form.
   Math., Biol., Physics, and Chemistry Booklet, one form.

DRY ICE

(Continued from page 12)

glass tubing; rubber connector tubing; dry ice; distilled water.

Directions: Set up the apparatus as shown in the diagram. Connect the absorption flask with an 18 inch length of rubber tubing. Place the salt, ammonium hydroxide and 65cc of distilled water in the absorption flask and shake violently for at least 10 minutes so that a saturated salt solution is obtained. Place several chunks of dry ice in the generator bottle and connect to the absorption flask. When the air is displaced from the apparatus, shake the absorption flask continuosly and violently so as to obtain as complete absorption as possible. Continue to supply liberal quantities of hydroxide mixture until a heavy creamy precipitate is formed. This will require about 30 to 40 minutes.

Remove the white solid to a filter paper in a funnel, allow to drain and then wash by pouring over it a few cc of cold water and letting it drain. Repeat the washing a second and third time, using a few cc only. (Note: A Buchner funnel and suction will speed up the filtration and give more satisfactory results in washing.) Remove the filter paper from the funnel and spread it out with the contents to dry on some paper towels.

Test your product by tasting it and by dropping a little dilute acid on a little of the powder in a test tube.

1. Write an equation to show how the sodium bicarbonate is formed.

2. Why does shaking greatly increase the rate of absorption?

3. How do you explain the heat produced in the absorption flask?

4. Why would not a precipitate form if carbon dioxide were passed into a common salt solution—you have all the material here for baking soda?

SOY BEAN RESEARCH

(Continued from page 9)

It has already been demonstrated in industry that defatted soybean meal can be used successfully as a modifier in the production of phenolic plastics and such application has accounted for all of the soybean meal consumed heretofore in the plastic field. Bearing in mind the possibilities of a more extended use of plastics by the development of very cheap molding compounds the laboratory has experimented extensively with defatted soybean meal in the production of such materials. When processed in a manner similar to that developed for soybean protein, that is, with formaldehyde, products were obtained which, while having good flow, possessed such poor water resistance that they crumbled to pieces when placed in water overnight. Replacement of formaldehyde by furfural led to great improvement in water resistance although the molded products were quite inferior in this respect to those made from soybean protein. It is apparent that considerable investigation will be required before defatted soybean meal may be considered as anything but a promising potential starting material for the production of cheap plastics having properties which will permit wide application.

In the development and engineering section of the laboratory the installation of pilot plant expeller press equipment and apparatus for the study of solvent extraction of soybean oil has been completed. The expeller press as set up is one-half dimension size of the presses commonly used in the industry and has a capacity of approximately 1.5 to 2 bushels of soybeans per hour. Several experimental runs have been completed and the installation has functioned very satisfactorily. As soon as standard conditions of operation have been established a detailed study will be initiated of the effect of varieties, particle size, moisture content, temperature effects, and other such variables on the efficiency of operation and the quantity of the oil and meal produced. An experimental solvent extraction apparatus was designed, fabricated, and installed in the laboratory during the past year. This equipment will permit the extraction of approximately 1 to 1.5 bushels of flaked soybeans under carefully controlled conditions. The apparatus has been constructed of 18-8 alloy with a high molybdenum content in order to minimize the danger of metallic contamination of the oil produced in it. This equipment has not as yet been put into use as its installation has been completed only recently.

Cooperative research projects have been set up with the Purdue University Agricultural Experiment Station on projects dealing with studies of the sterols, phosphatides, and carbohydrates of the soybeans, and considerable progress has been made during the past year in our knowledge of soybean sterols and phosphatides. The most important accomplishment has been the isolation of stigmasterol, an important starting materials in the synthesis of sex hormones. According to the experimental results obtained thus far stigmasterol makes up approximately 25 per cent of the total sterols of the soybean. It is entirely possible that this important sterol may be economically recovered from the oil during some stage of soybean processing operations.

A cooperative project has been set up recently with the University of Minnesota Agricultural Experiment Station. This project deals with the study of the respiration of soybeans when stored under certain conditions of moisture content, humidity, and temperature. This work has been under way for only a few months and consequently only limited progress can be reported at the present time.

The accomplishments to which attention has been called in the foregoing are recorded, not from the standpoint of finality by any means, but merely to point out for your information the trends which the work of the laboratory is assuming. It should be emphasized that most of the experimental work reported in this paper has been underway for less than one year, and hence should be construed as indicating only the possibilities which lie ahead, rather than the definite attainment of objectives. The prospects are bright for further industrial use of soybean products. The chief prerequisites for such broadened applica-

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BIOLOGY-MINDED COMMUNITY

(Continued from page 3)

the direct classroom teaching of socially significant material.

And, in the formation of our biology clubs, it might be well to forget the usual conventional organization and turn to such types as "Wild Life Conservation Clubs", "Garden Clubs", "Pet Clubs", Community exhibits and fairs, Community Planting Organizations, Health and Recreation Groups, and to remember that Boy Scout and Girl Scout organizations are in dire need of biological assistance —in nature studies, in first aid, and in sanitation.

The general type of approach in the production of a biology-minded community has undoubtedly been much better expressed by Froebel about one hundred and fifty years ago at a time when there was no such thing as a public school system. Froebel's words are: "Let the son accompany his father everywhere, to the field, to the garden, to the shop, to the counting house, to the forest, and to the meadow; in the care of domestic animals and in the making of small articles of furniture; in the splitting, sawing, and chopping of wood; in all of the work which his father's calling involves. Questions upon questions come from the lips of the boy thirsting for knowledge — When? How? Why? What? What for? Of what? And every satisfactory answer may open up a new world to the boy." Modern civilization has become so specialized since Froebel's time that the son cannot accompany the father in this manner, but, if you substitute the word "teacher" for "father", I think that Froebel has made my meaning quite clear.

No doubt, some of you, with a great and justifiable faith in the value of a strictly scientific point of view may think that all of this is a travesty upon scholarship, and you might well quote Barry, who says, "From the humanistic as well as from the purely intellectual point of view, the general acquisition of scientific knowledge is of far less consequence than the inculcation of the scientific habit of thought." Yet I assure you, if you are one of these, that it takes far more scholarship and even more insight into the "inculcation of the scientific habit of thought" for community problem solving than it does for the more abstract classroom procedures. This kind of problem-solving soon becomes indistinguishable from scientific research. I mention this because there is a fear in some quarters that scientific methods and accuracy may be sacrificed upon the altar of public approval—none of us must countenance that.

In conclusion, then, let us recognize that the community does have demands which a biology department should meet, and that a biology department does not live up to its high estate if such social objectives are not included in the biology body corporate. There is not a single biology teacher here who cannot do some one thing for his community. That is enough for a starter, and it will take plenty of your time, and, as one grows in years and experience, other things may be gradually added. Also, one thus discovers his limitations, and the more willingly finds means to strengthen such weakness by additional planning of co-operative enterprises, observation, study, work, or even schooling.

A SERVICE PUBLICATION FOR BIOLOGY TEACHERS

Beginning in January of this year a new service publication of considerable merit is being published by Denoy-Geppert Company of Chicago. It is ably edited by Dr. H. Sigler of the educational department of their staff. Each issue brings much usable material for the teacher. For example, the first issue presented an excellent article on Collecting and Cultivating Protoza, the February issue discussed the Collecting and Preserving Various Marine Organisms, the April issue presented Photomicrography, other issues likewise present some one thing of special interest to biology teachers. Other features are also included among which may be mentioned book reviews, question and answer column, etc. This publication, known as Biology Briefs, is remarkably free of advertising and is quite acceptable. Biology teachers may receive the publication gratis by writing the editor, Mr. H. Sigler, Denoyer-Geppert Company, 5235 Ravenswood Avenue, Chicago, Illinois. Back numbers may also be obtained as long as they are available.

FIELD WORK IN BIOLOGY

(Continued from page 17)

12. Wildflowers of America. Jane Harvey. Whitman Publ. Co., Racine, Wis. Price 10c.
13. The Redbook of Birds, The Blue Book of Birds, and the Green Book of Birds of America. F. G. Ashbrook, Whitman Publ. Co. Price 10c each.
14. Manual of Cultivated Plants. Liberty H. Bailey.
15. Fresh Water Biology. Ward & Whipple. Wiley, N. Y. Keys for Plankton & Invertebrates.
16. A Synopsis of the Reptiles and Amphibians of Illinois. H. Garman. Bull. Ill. St. Lab. Nat. Hist. Vol. 3, No. 13.
17. The Spider Book. J. H. Comstock.
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2'. Fieldbook of Insects. F. E. Lutz. Putnam, N. Y.
23. Handbook of Protozoology. R. R. Kudo. Thomas, Springfield, Illinois.
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GENERAL REFERENCES.

1. Available Publications of the Natural History Survey. Theodore A. Frison, chief, Nat. Hist. Surv. Div., Urbana, Illinois.
2. Turtox Service Leaflets. Gen. Biological Supply House, Chicago, Illinois. Fee.
3. Animal Project, Bird Project. Tree and Flower Project. 3 books. Madalene B. Sawyer and Grace M. Seymour. P. O. Box 4, Jamaica Plain, Mass. Price 40c each.

SOY BEAN RESEARCH

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tions are a more precise knowledge of the physical and chemical properties of the materials for which uses are sought and more definite information concerning the chemistry of the processes through which these materials must pass in industrial utilization. The only road over which we may travel safely toward these desired destinations is the highway of research.

BOOK SHELF

SCIENCE PROBLEMS, BOOK TWO, by Wilbur L. Beauchamp (University of Chicago), John C. Mayfield (University High School, Chicago), and Joe Young West (Maryland State Teachers College, Towson). About 600 pages, size 8¼x5½"; about 400 pictures. January 1939. Scott, Foresman and Company. Second book of the junior-high school series of the Basic Studies in Science Program.

When Book One of the SCIENCE PROBLEMS series made it appearance last fall, it was welcomed as the first of a new type of junior-high science books. Here was a complete new program, not high-school science rewritten or boiled down to junior-high size; here were books written especially for pupils of junior-high age. The authors recognized that the all-too-common practice of introducing the child to large, complex environmental units without adequate preparation beforehand was impractical at this level. Now, by lining up Books One and Two we are able to see more clearly how they have gone about solving this difficulty and what the publishers of SCIENCE PROBLEMS mean when they speak of a course of study which develops science principles in an orderly, cumulative manner through problem sequences before attacking larger environmental problems.

In Book One, for example, units on the nature of Matter, the effect of Heat and Cold on Matter, Physical Change and Chemical Change are first studied before the child is introduced to such a complex problem as the use and control of Fire. Book Two follows the same plan and introduces a distinct innovation in carrying out the cumulative approach. Where principles developed in Book One are necessary for solving problems in Book Two, questions marked with an asterisk (*) in the introductory exercises at the beginning of the unit serve to recall this knowledge from the previous book. If the pupil doesn't remember the material, the mark tells him automatically that by reviewing Book One he can find the answer and that these principles are needed in solving problems in the new unit.

Larger than Book One, this new SCIENCE PROBLEMS book is just as handsome a piece of work with its large pages, modern type and page lay-out, and plenty of up-to-date teaching pictures. In the back there are lists of recommended readings for each unit and a complete pronunciation and science work-meanings glossary. Units, as in Book One, are broken up into problems and sub-problems. Experiments and self-testing exercises are used in developing and applying science understandings . . . So much for two books which incorporate almost everything necessary to encourage children to want to study science.

VISUAL AIDS IN PHYSICS

(Continued from page 11)

the ancient guild systems. The physics teacher is in a position to study the habits and ability of the students in his class so that new boys may be added to the training group each semester. Thus, at all times experienced operators are available.

A movie operators' club may also be formed. The boys meet once a week with the teacher for instructions during activity period. Details of the operating schedule for the next week may be worked out during this period as well as the holding of interesting discussions on such topics as high speed photography of colored objects and the taking of pictures by the aid of polarized light.

There is probably little need to comment here that these boys are easily impressed with the importance and responsibility of their positions. To stimulate their efforts still further, they may be allowed to work to certain positions such as that of first class or expert operator according to their qualifications to become efficient. Credit may also be given toward graduation on the same basis as for teacher assistants. Although it is not the direct aim of the physics students' activity in the visual aids program to train for citizenship, this by-product may well be stimulated by the opportunity to exercise personal dependability in applying the principles of physics in the manipulation of the fine machinery.
